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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Operational Test and Evaluation, Defense	Date: February 2020
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Appropriation/Budget Activity					R-1 Program Element (Number/Name)							
0460: Operational Test and Evaluation, Defense / BA 6: RDT&E Management Support					PE 0605131OTE / Live Fire Test and Evaluation (LFT&E)							
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	58.950	64.332	69.172	70.933	-	70.933	70.297	72.989	74.001	75.034	Continuing	Continuing
000311: LFT&E	58.950	64.332	69.172	70.933	-	70.933	70.297	72.989	74.001	75.034	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element consists of three programs: Live Fire Test and Evaluation (LFT&E), Joint Aircraft Survivability Program (JASP), and Joint Technical Coordinating Group for Munitions Effectiveness (JTCEG/ME).

This Program Element directly supports the Congressional statutory requirements for oversight of LFT&E. The primary objective of LFT&E is to assure that the vulnerability and survivability of Department of Defense (DoD) crew-carrying platforms and the lethality of our conventional munitions are known and acceptable before entering full-rate production. LFT&E encompasses realistic tests involving actual United States (U.S.) and foreign threat hardware or, if not available, acceptable surrogate threat hardware. The objective is to identify and correct design deficiencies early in the development process. A completed LFT&E program and test report is required before programs proceed beyond low-rate initial production (BLRIP). LFT&E also includes realistic modeling and simulation (M&S) to examine survivability and lethality attributes not assessed during testing.

This Program Element also supports DoD's Joint Live Fire (JLF) Program and other LFT&E related initiatives. JLF was initiated in 1984 under an Office of the Secretary of Defense charter to test fielded front-line combat aircraft and armor systems for their vulnerabilities as well as fielded weapons, both U.S. and foreign, for their lethality against their respective targets. Funds are also used to support other initiatives related to quick reaction requests from theater and other areas of personnel survivability.

The Joint Aircraft Survivability Program is the DoD's focal point for joint service enhancement of military aircraft non-nuclear survivability. The JASP is chartered by the commanders of the USN Naval Air Systems Command, USA Aviation and Missile Command, and USAF Life Cycle Management Center to increase the affordability, readiness, and effectiveness of Tri-Service aircraft through joint coordination and development of survivability technologies, design tools and assessment methodologies. The JASP coordinates and conducts RDT&E to improve military aircraft survivability, develop and standardize aircraft survivability modeling and simulation (M&S), facilitate information exchange on aircraft survivability, and support aircraft survivability education for the DoD and U.S. aircraft community. Each chartering command provides a senior aircraft survivability expert for the JASP Principal Members Steering Group (PMSG), which guides the program and approves projects for funding. The JASP assesses and reports on combat damage incidents through the Joint Combat Assessment Team (JCAT) and is the Executive Agent for the Joint Live Fire Aircraft Systems Program managed by the Live Fire Test office of DOT&E.

The Joint Technical Coordinating Group for Munitions Effectiveness (JTCEG/ME) was chartered 50 years ago to serve as Department of Defense's (DoD's) focal point for munitions effectiveness information. The JTCEG/ME produces Joint Munitions Effectiveness Manuals (JMEMs) that are the sole source for all Joint Service Authenticated non-nuclear weapons effectiveness data and methodology for DoD. The JMEMs are the "how to" manuals for putting ordnance on target and as such, directly impacts combat readiness, effectiveness, and survivability. JMEMs are used by the Warfighters in operational weaponeering and collateral damage estimation calls in direct support of operations, mission planning, and training; by the DoD, Joint, and Service planners in force-on-force modeling, mission area analysis, requirements studies and weapon procurement planning; and by the service acquisition community in performance assessment, analysis of alternatives and survivability enhancement

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Appropriation/Budget Activity 0460: <i>Operational Test and Evaluation, Defense / BA 6: RDT&E Management Support</i>	R-1 Program Element (Number/Name) PE 0605131OTE / <i>Live Fire Test and Evaluation (LFT&E)</i>
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studies. The JTCG/ME continually evolves weapons effectiveness and target vulnerability data, standards, methodologies, and processes based on the strategic environment for better munitions effectiveness evaluation and support to a more lethal force. JTCG/ME also increases efficiency by leveraging ongoing Department efforts and supporting the Department's intent to complement U.S. interest and capabilities by providing weaponeering and targeting capability to Coalition partners. The JMEM requirements and development processes are driven by operational lessons learned (Inherent Resolve, Resolute Support and Freedom Sentinel), Joint Staff Data Call and the needs of Combatant Commands (CCMDs), Services, Military Targeting Committee (MTC) guided by Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 5140.01, Munitions Requirements Process (MRP) - DoD Instruction (DoDI) 3000.04 and Operational Users Working Groups (OUWGs) input for specific weapon-target pairings and methodologies. Considerable effort goes into these user forums to establish Warfighter requirements for current and future JTCG/ME products, as well as continued training events and day-to-day support -- all with the goal of enabling greater force lethality, strengthening partner capabilities, and optimal use of resources.

This program element also includes funds to obtain Federally Funded Research and Development Center (FFRDC) expertise in performing analyses in support of described Live Fire Test and Evaluation tasks, as well as travel funds to carry out the LFT&E, JASP, and JTCG/ME programs.

B. Program Change Summary (\$ in Millions)	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021 Base</u>	<u>FY 2021 OCO</u>	<u>FY 2021 Total</u>
Previous President's Budget	64.332	69.172	70.933	-	70.933
Current President's Budget	64.332	69.172	70.933	-	70.933
Total Adjustments	0.000	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Operational Test and Evaluation, Defense										Date: February 2020		
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000311: <i>LFT&E</i>	58.950	64.332	69.172	70.933	-	70.933	70.297	72.989	74.001	75.034	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

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This Program Element directly supports the Congressional statutory requirements for oversight of LFT&E. The primary objective of LFT&E is to assure that the vulnerability and survivability of Department of Defense (DoD) crew-carrying platforms and the lethality of our conventional munitions are known and acceptable before entering full-rate production. LFT&E encompasses realistic tests involving actual United States (U.S.) and foreign threat hardware or, if not available, acceptable surrogate threat hardware. The objective is to identify and correct design deficiencies early in the development process. A completed LFT&E program and test report is required before programs proceed beyond low-rate initial production (BLRIP). LFT&E also includes realistic modeling and simulation (M&S) to examine survivability and lethality attributes not assessed during testing.

This Program Element also supports DoD's Joint Live Fire (JLF) Program and other LFT&E related initiatives. JLF was initiated in 1984 under an Office of the Secretary of Defense charter to test fielded front-line combat aircraft and armor systems for their vulnerabilities as well as fielded weapons, both U.S. and foreign, for their lethality against their respective targets. Funds are also used to support other initiatives related to quick reaction requests from theater and other areas of personnel survivability.

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The Joint Technical Coordinating Group for Munitions Effectiveness (JTCEG/ME) was chartered 50 years ago to serve as Department of Defense's (DoD's) focal point for munitions effectiveness information. The JTCEG/ME produces Joint Munitions Effectiveness Manuals (JMEMs) that are the sole source for all Joint Service Authenticated non-nuclear weapons effectiveness data and methodology for DoD. The JMEMs are the "how to" manuals for putting ordnance on target and as such, directly impacts combat readiness, effectiveness, and survivability. JMEMs are used by the Warfighters in operational weaponeering and collateral damage estimation calls in direct support of operations, mission planning, and training; by the DoD, Joint, and Service planners in force-on-force modeling, mission area analysis, requirements studies and weapon procurement planning; and by the service acquisition community in performance assessment, analysis of alternatives and survivability enhancement

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<p>studies. The JTCG/ME continually evolves weapons effectiveness and target vulnerability data, standards, methodologies, and processes based on the strategic environment for better munitions effectiveness evaluation and support to a more lethal force. JTCG/ME also increases efficiency by leveraging ongoing Department efforts and supporting the Department’s intent to complement U.S. interest and capabilities by providing weaponeering and targeting capability to Coalition partners. The JMEM requirements and development processes are driven by operational lessons learned (Inherent Resolve, Resolute Support and Freedom Sentinel), Joint Staff Data Call and the needs of Combatant Commands (CCMDs), Services, Military Targeting Committee (MTC) guided by Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 5140.01, Munitions Requirements Process (MRP) - DoD Instruction (DoDI) 3000.04 and Operational Users Working Groups (OUWGs) input for specific weapon-target pairings and methodologies. Considerable effort goes into these user forums to establish Warfighter requirements for current and future JTCG/ME products, as well as continued training events and day-to-day support -- all with the goal of enabling greater force lethality, strengthening partner capabilities, and optimal use of resources.</p> <p>This program element also includes funds to obtain Federally Funded Research and Development Center (FFRDC) expertise in performing analyses in support of described Live Fire Test and Evaluation tasks, as well as travel funds to carry out the LFT&E, JASP, and JTCG/ME programs.</p>				
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Title: Live Fire Test and Evaluation		64.332	69.172	70.933
FY 2020 Plans: Live Fire Test and Evaluation (LFT&E) of Major Department of Defense (DoD) Acquisition Programs The FY 2020 budget will enable the LFT&E Deputate to: (1) assess the adequacy of programs’ test and evaluation plans and generate new test and evaluation policies, as needed; (2) review and analyze the test data to support an independent evaluation of the survivability/lethality of the systems in support of the development of OSD Live Fire Test and Evaluation reports to Congress; and (3) review major acquisition plans, reports, and requirement documents to inform system design and capability development.				
JLF Programs and LFT&E Initiatives The FY 2020 JLF budget will support at least 20 projects (tentatively 8 new efforts and 12 projects continuing from previous FYs). Project’s objectives will directly support NDS objectives to include building a more lethal force, new partnerships, or DoD business reforms.				
Build a More Lethal Force In FY 2020, JLF will continue to increase the accuracy and capability of critical modeling and simulation tools to support test and evaluation efficiency and ensure credibility of DOD assessments and weaponeering tools. - For example, one effort will increase the capability of existing naval M&S survivability and lethality evaluation tools. More specifically the project will develop more accurate damage effects as the threat penetrates multiple ship compartments, as typically seen in a realistic engagement.				

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>- Another effort will increase the capability of existing M&S tools used to evaluate fire propagation across ship compartments and the ensuing threat to the ship/occupants, as well as recoverability capabilities pertaining to the damage caused by spreading fires.</p> <p>JLF efforts will also continue to resolve survivability and lethality related system design challenges of currently fielded U.S. systems.</p> <p>- For example, one JLF effort will address an evaluation shortfall related to body armor performance. Existing LFT&E methods do not adequately correlate body armor data to actual injury. This task will support the development of appropriate measures, techniques, and analyses to enable a more credible correlation of body armor data with injury.</p> <p>- JLF will enable the development of more rigorous test infrastructure needed to evaluate the effectiveness of fuel self-sealing bladders with aircraft. Self-sealing bladders could significantly mitigate the vulnerability to the aircrew. This test infrastructure will ensure self-sealing bladder's performance is more accurately characterized prior to final design reviews.</p> <p>Reform the Department for Greater Performance and Affordability</p> <p>In coordination with the Army and the Air Force, JLF will increase aircraft and ground combat vehicle survivability/lethality M&S.</p> <p>- One effort will apply innovative techniques to increase the efficiency of existing M&S tools largely used to estimate lethality of piercing threats against our systems. Improved lethality models will increase the credibility of our lethality evaluations and the credibility of weapon engineering tools.</p> <p>JLF will also continue to lead innovation in LFT&E methods to increase LFT&E efficiency and support rapid fielding.</p> <p>- A new effort will develop an advanced teaming analysis capability to enable future survivability and lethality evaluations of a system-of-systems. Current LFT&E has limited capability to assess the effectiveness of the system in the context of other supporting systems. LFT&E is currently constrained to single system analyses, which is not always operationally representative.</p> <p>- Another new JLF effort will provide an M&S capability that will enable efficient evaluation of active protection systems integrated with ground combat vehicles.</p> <p>- JLF will develop machine learning algorithms to more effectively characterize armor performance. Such algorithms will enable efficient LFT&E of future armor compositions and will inform future armor designs.</p> <p>JASP</p> <p>In FY 2020 the JASP will continue work on 27 multi-year RDT&E projects and initiate 13 new projects approved by the JASP Principal Members Steering Group and OSD/DOT&E. The JASP will support the NDS objective to 'Build a More Lethal Force' by developing measures to defeat Near-Peer Adversary Threat (N-PAT) radio-frequency and infrared guided threats coupled with quantifiable improvements in digital and hardware in the loop modeling and simulation capability and credibility. Improve aircraft force protection by advancing system hardening against rocket-propelled grenade, small-arms, and high-energy laser threats and increasing threat and flight environmental situational awareness. Reform the DoD for Greater Performance and Affordability by</p>			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>funding the development of more efficient M&S tools and threat models to enable more effective aircraft survivability capability development, test and evaluation.</p> <p>The Joint Combat Assessment Team (JCAT) will continue to support the Air Force, Army, Marine Corps and Navy by assessing combat damage incidents, training operators on threat effects and combat damage assessment, and reporting their findings to combatant commanders and the DoD science and technology and acquisition communities. The JASP will continue supporting aircraft survivability education and information exchange through internet sites (restricted access and classified), by publishing the Aircraft Survivability Journal, developing educational materials and conducting training for the DoD and their contractors. The JASP will initiate, continue, and complete other projects as approved by the JASP Principal Members Steering Group and OSD/ DOT&E.</p> <p>Joint Technical Coordinating Group for Munitions Effectiveness In FY 2020, JTCCG/ME efforts will continue to assist the Director, Operational Test and Evaluation (DOT&E), Office of the Secretary of Defense (OSD) in supporting the National Defense Strategy lines of effort of enabling greater force lethality, strengthening partner capabilities, and optimal use of resources through efficiency.</p> <p>JTCCG/ME will:</p> <ul style="list-style-type: none"> -Develop, enhance, and standardize data/methodologies for evaluating munitions effectiveness. This includes target vulnerability characterization, munitions lethality, weapon system accuracy, and specific weapon-target pairings driven primarily from current operational lessons learned, Joint Staff Data Calls, and Combatant Commands' (CCMDs) needs. -Field and continue to enhance future versions of its kinetic JTCCG/ME Joint Munitions Effectiveness Manual (JMEM) products to include the JMEM Weaponizing System (JWS), Joint Anti-air Combat Effectiveness (J-ACE), Digital Precision Strike Suite (DPSS) Collateral Damage Estimation (DCiDE) tool, and the Digital Imagery Exploitation Engine (DIEE). -Develop non-kinetic JMEMs capability to include Cyber Operations Lethality and Effectiveness (COLE) and Joint Laser Weaponizing Software (JLaWS) products, as well as High Power Microwave (HPM) and Electromagnetic Spectrum (EMS) Fires data/tool sets. -Support specialized solutions to address operational needs to include direct analytical support to operations, Probability of kill (Pk) Lookup Tools, Collateral Damage Estimation (CDE) analysis and tables, and air-to-surface and surface-to-surface weaponizing guides. -Continue to execute a multi-year test program to enhance weaponizing/collateral damage estimation in complex environments. -Improve the utilization of Battle Damage Assessment (BDA) data to more effectively and efficiently estimate munition expenditure rates and mitigate stockpile stress, while improving CCMDs' force effects. -Continue to maintain and strengthen relationships with the Warfighter, operational users, and coalition partners to establish requirements for current and future products, through forums, training, foreign military sales, and reachback operational support. 			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>The objective is to provide efficient and effective support to meet CCMD current and future needs for agility and greater lethality in a more dynamic combined operational environment.</p> <ul style="list-style-type: none"> -Increase efficiency by leveraging ongoing Department efforts and support the Department's intent to complement U.S. interest and capabilities by providing weaponeering, targeting, and collateral damage estimation (prevent civilian casualties) capability to Coalition partners through foreign military sales. -Continue to build and implement the next JTCG/ME JMEM product lines on a foundation of effects libraries using software frameworks enabling quicker development, flexibility, leveraging, and tailoring. -Study and implement the use of machine learning and data analytics to improve quality of existing solutions, decrease computation time of applications, and answer questions previously not possible. <p>Specifically in FY 2020, JTCG/ME plans to:</p> <ul style="list-style-type: none"> -Sustain/support fielded JWS v2.3.1, with efforts including multiple training and user forums for the fielded product. -Field JWS v2.4/develop JWS v2.4.x updates (as needed), which provides enhanced data, Fast Integrated Structural Tool (FIST), and connectivity capabilities, while maximizing the final JWS v2.x product line as the future weaponeering product line is developed/completed. Specific highlights include interim enhanced database capabilities with updated data sets to include CCMD's high priority calculated, refreshed, and surrogated targets. The enhanced database capabilities allow accelerated, out of production cycle weapons and target data updates, tailored product versions for releasability, and more effective, focused testing. New capabilities include Hard Target Void Sensing Fuze and trajectory model updates, as well as FIST v2.4 with several expanded methodologies for structural target response variables. These capabilities enable more options to the weaponeer and improve the underlying phenomenology representation in JWS. -Facilitate coalition interoperability and information exchange forums. JTCG/ME will deliver JWS version releases and standalone Pk Lookup tools to coalition partners in support of current operations under Foreign Military Sales agreements. These deliveries increase efficiency by leveraging ongoing Department efforts and supporting the Department's intent to complement U.S. interest and capabilities by providing weaponeering/targeting and collateral damage estimation capability to Coalition partners, as well as improve the effectiveness of U.S. fires and targeting personnel working in combined environments. JTCG/ME will also hold information exchange forums via information exchange agreements (IEAs) with the United Kingdom and Republic of Korea. These exchanges facilitate collaboration on methodologies and efforts of mutual interest in the area of weapons effectiveness/collateral damage estimation. These efforts will directly support Presidential Conventional Arms Control Policy to build partner capacity to prevent civilian casualties. -Develop and enhance processes to supply target vulnerability data to operational and acquisition communities. The JTCG/ME conducts detailed vulnerability analysis to produce tri-service approved target vulnerability information (i.e., Target Geometric Model (TGM) development, Failure Analysis Logic Tree (FALT), Failure Mode, Effects, and Criticality Analysis (FMECA), etc.). These data are used to feed the approved vulnerability models to generate the target data used on JMEMs. In addition, acquisition programs leverage JTCG/ME target vulnerability data to conduct detailed analysis of their new capabilities against 			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>threat targets. Similarly, JTCG/ME leverages target vulnerability modeling capabilities developed during acquisition. The leveraging of this information saves programs and JTCG/ME valuable time and resources, and ensures the acquisition and operational communities are using consistent/valid threat representation and similar vulnerability/lethality modeling capabilities. A significant focus of FY 2020 efforts will be planning and transition of target vulnerability capabilities to the JMEM Effects Library (JEL) for use on next generation weaponeering and targeting JMEMs.</p> <p>-Support urgent operational needs for target vulnerability data with rapid response surrogation and development of Pk Lookup data for high priority weapons and targets. These specialized products directly assist CCMDs to meet the operational requirements of a dynamic environment.</p> <p>-Continue to collect/improve, approve, and supply weapons characteristics data and standards for the tri-service community to include soon to be fielded systems. These weapons are: Small Diameter Bomb (SDB) II; Small Glide Munition (SGM) GBU-69; Focused Lethality Munition (FLM) GBU-39; Joint Air-to-Ground Missile (JAGM); Joint Multiple Effects Warhead System (JMEWS); Advanced Anti-Radiation Guided Missile (AARGM); and High speed Anti-Radiation Missile (HARM). JTCG/ME also continues to monitor future weapon systems to work longer lead methodology needs. A significant focus of FY 2020 efforts will be planning and transition of weapons characteristics capabilities to the JEL (database design, integration, and interfaces) for use on next generation weaponeering and targeting JMEMs.</p> <p>-Enhance weapons characterization processes and communication through the JTCG/ME Test Assistance Group (TAG). The TAG provides a forum that fuses science and art of weapon testing with subject matter experts from all the services and test ranges to review, adopt technologies and methods that reduce expense, time, anomalies, and expanded data collection. JTCG/ME archives and publishes these weapon characterization standards in updates to the JTCG/ME Weapon Test Procedures Manual (TPM) used by weapon test ranges. The TAG also facilitates partnerships and leveraging with Program Managers, Program Executive Offices, and Service Program Offices. These technologies and partnerships have the potential to reduce the number of weapon test articles required and remove labor-intensive activities from weapon testing.</p> <p>-Maintain, update, and execute strategic roadmaps for underlying vulnerability / lethality models used as standards by the tri-service community to better support JMEM development and Live Fire Testing and Evaluation (LFT&E). These roadmaps align JTCG/ME funded and related tasks by other services and programs to facilitate leveraging. In addition, the roadmaps provide a tool for future investment planning to support modeling / simulation validation and resolution of capability gaps. A key roadmap component includes several interconnected model sensitivity studies. The goal of these studies is to understand the range of potential model outputs, including stochastic variations in penetration and other processes, so that differences between test data and predictive models can be better understood.</p> <p>This will be used to guide live fire testing requirements for validation of the models for a program office's specific operational envelope. These studies will also provide data to support several model reaccreditations.</p> <p>-Develop and accredit Collateral Effects Radii (CER) Reference Tables in accordance with the Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3160.01 series, "No-Strike and the CDE Methodology" for air-to-surface and surface-to-surface weapons, which are the basic data that support the CDE methodology. The JTCG/ME CER tables and CDE methodology are used in</p>			

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<p>every planned kinetic strike in all Areas of Responsibility Operation (AORs) to meet Commanders' intent and to minimize civilian casualties. As such, it is critical to the Warfighters' ability to meet urgent operational needs. JTCG/ME implements the CER and CDE methodology within the DCiDE tool. DCiDE is an accredited automated CDE tool that expedites and simplifies the CDE process. DCiDE enables JTCG/ME to continuously support the CJCSI 3160.01 series, DCiDE was the only automated CDE tool authorized for use in the USCENTCOM and USAFRICOM AORs.</p> <p>-Maintain and support DIEE v2.2.1 product. DIEE is designated by CCMD Action Group (CCAG) as DoD solution for Advanced Target Development (ATD). DIEE provides both seamless planning and linkage to various mission planning systems and tools in operational units. It is a "Government off the shelf" (GOTS) product for advanced target development that integrates Target Coordinate Mensuration (TCM), CDE, Weaponneering, and data basing functions. DIEE was selected as the preferred operational solution of a 2018 Air Force Advanced Target Development (ATD) Software Fly-off based on 135 hours of hands-on time and 451 scored line items. The Chairman of the Joint Chiefs of Staff issued guidance stating that, "The Services, Combatant Commands, and Combat Support Agencies will upload and use DIEE v2.1 for automated CDE to comply with the updated methodology and reporting requirement." DIEE v2.1.1 includes user requested enhancements, more advanced JWS interface for weaponneering capability, CJCSI 3160.01C compliant CER Reference Tables and DCiDE for CDE capability, and updated Common Geopositioning Services (CGS) for TCM capability. A significant update in DIEE v2.2.1 is implementation and integration of mitigation tables for CDE. These mitigation tables, codified for use in CJCSI 3160.01C, are weapon and target specific, and allow for more accurate civilian casualty estimates for consideration by the strike authority. DIEE v2.2.1 supports various mitigation techniques that provide increased operational flexibility within the context of Theater Rules of Engagement and the Laws of Armed Conflict.</p> <p>-Continue to develop future DIEE versions (v2.x/v3.x) that will include: CGS updates, 3-D viewer for pre- and post- processing of weaponneering and CDE mitigation analyses, interfacing to future JEL capability for weaponneering, updates to Collateral Effects Library (CEL) interface, battle damage assessment workflow and graphic production, route tool user requested enhancements, and mobile tablet capabilities. JTCG/ME maintains Warfighter support and future requirements collection through training and User forums. A focus of FY 2020 efforts will be the transition of CJCSI 3160.01C to CJCSI 3160.01D and the impact on CERs and DCiDE implementation.</p> <p>-Continue to leverage CEL and other high fidelity weaponneering/CDE techniques to deliver analysis packages for collateral damage mitigation, post-forensic, and force protection analyses packages to operational Users for high value targets in current operations. These efforts directly assist Combatant Commands to meet commander's intent and minimize collateral damage.</p> <p>-Continue the Enhanced Weaponneering and CDE Program, a multi-year test program focused on enhancing and validating JTCG/ME CDE tools. This program will support improvements in weaponneering methodology to minimize risk to mission and risk to forces, while not increasing risk of collateral damage, by providing foundational data for the development of higher fidelity predictive tools. Specific efforts will generate buried ordnance characterization data based upon usage statistics from CCMD Expenditure reports, and AOR specific building debris data to enhance and validate current weaponneering/collateral damage estimation methodologies required by Strike Approval Authorities. FY 2020 efforts leverage nine FY 2019 testing events and</p>			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>multiple collaboration forums. FY 2020 tests will include three buried ordnance tests to evaluate the effects of burial and weapon class on warhead performance, crater ejecta, and collateral damage, and four building debris characterization tests. A focused effort of FY 2020 is transition of previous years' analyzed and processed data to methodologies and future JMEM products.</p> <p>-Continue to implement the BDA of Deliberate and Dynamic Strikes analysis efforts. These efforts are multi-year task to analyze ongoing strikes required to update JMEM capabilities. The overall objective is to ensure effective and efficient munition expenditure rates and mitigate the stockpile stress, while improving CCMDs' force effects. This will improve the warfighter's ability to get the right weapon on the right target, achieve the desired effect, and minimize collateral damage while optimizing scarce resources. The analysis approach includes: 1) establishing an analytical cell to provide a detailed and usable Department-level combat assessment of past, current, and future strikes/weapons employments, 2) establishing an archival database that captures the pre- and post-strike assessments of these engagements, in a format that will be called upon by DICE to select strike packages with optimal and efficient munition expenditures, and 3) guiding tactics improvement for evolving environments and methodology development to improve weaponizing tools. FY 2020 efforts include configuring cloud computing environment for BDA data/web tools, aggregating strike data and migrating to cloud, improving/automating data collection process, developing methodologies for multiple use cases, automating portions of strike analysis methodology, obtaining user feedback on web interface/tools and new BDA requirements, refining interface/tools based on User feedback, and refining accuracy of weapons effects/tools based on BDA results.</p> <p>-Sustain/support fielded J-ACE v5.3/v5.3.1. J-ACE, which includes the Joint Anti-air Model (JAAM) and Endgame Manager (EM) modules. J-ACE provides two-sided air-to-air/surface-to-air combat effectiveness capability to underpin air combat tactics, techniques, and procedures development, as well as support mission analysis, studies, and training. Many users leverage J-ACE's Application Program Interface (API) to link debrief and analysis tools at training and test ranges across the Joint community. FY 2020 efforts will include multiple training and user forums for the fielded product. These forums are pivotal for J-ACE developers to understand requirements, and align development with other external debrief/analytical capabilities that use J-ACE as the underlying analytical engine to underpin results. The forums allow J-ACE external application developers to receive any updates and interact with J-ACE developer to refine requirements and plans.</p> <p>-Finish J-ACE v5.4 development. Further J-ACE v5.4 product development will maximize the final J-ACE v5.x product line, and continue to deliver User with new capability, as the future v6.x product is developed/completed. J-ACE v5.4 will include updated weapons and aircraft data in JAAM, new cross platform BROWSE module, which contains descriptive information for each player (weapon, aircraft). In addition, J-ACE v5.4 will include a new EM module that simulates terminal effects of the weapon lethality and target vulnerability. The faster EM has improved speed of new fuze model and refined graphic display data generation, and includes more weapon lethality-target vulnerability data sets. Other capabilities will include time, space, and position information (TSPI) file updates and filtering/error identification, aircraft maneuver updates, new input/output control options for a "war room summary sheet, and initial air-to-surface weapon (ASW) fly out models.</p> <p>-Further development of the Air Combat Effectiveness Library (ACEL) and the next J-ACE product series capabilities, known as J-ACE v6.x. Future JTCG/ME product lines (applications) are being designed and built on a foundation of effects libraries, which</p>			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>are collections of JTCG/ME approved data, models, and methods/capabilities. Effects libraries are integrated using software frameworks, which support plug-in style methodologies enabling maximum modularity, flexibility of design, and reuse of standard capabilities across the community for greater performance and affordability. ACEL uses Hybrid Interactive Visualization Engine (HIVE) as its software architecture, which is used by others in the aircraft survivability community, enabling greater leveraging. ACEL will serve as the underlying analytical engine for weapons shot-logic/effect and weapons/aircraft kinematic calculations, while J-ACE v6.x and application interfaces will enable Users to interact with and use ACEL capabilities in a tailored software application to predict air combat effectiveness. FY 2020 efforts and deliverables will include continued review/approval of transported v5.x capabilities to ACEL and continued development of new v6.x capabilities. J-ACE v6.0 threshold capabilities include unmanned aerial system features, enhanced weapon engagement zone methodology, new graphical displays, refined terrain masking options, and auto-generated test reports for each product player. J-ACE v6.0 objective capabilities include enhanced air-to-air missile modeling capability, more ASW fly outs, updated/new surface-to-air models, updated enhanced surface-to-air missile simulation (ESAMS) capability with more counter measures, and target detection capability leveraging National Air and Space Intelligence Center (NASIC) Radio Frequency (RF) models/data. Longer -lead development items include infrared detection/track, red surf-to-air gun modeling in EM, rotary wing aero performance modeling, and enhanced chaff modeling.</p> <p>-Continue to mature Cyber JMEM capabilities with continued execution of multiyear plan to develop the COLE tool. FY 2020 efforts will focus completion of capability drop (CD) 2 efforts to include: advanced calculations incorporating quantification of uncertainties, ingest and generate operational environment model (OEM) data, prototype functional and beta tests, advanced uncertainty modeling (Monte Carlo, etc.), and computation of path-to-target estimate. In addition, FY 2020 will begin development of CD 3 that will include automated fusion of multi-domain estimates, correlation of foundational data to support OEM generation, preliminary artificial intelligence-based decision support system, OEM analysis and attack planning support, refined integration with other JTCG/ME toolsets, and quantitative comparisons. Similar to other JMEMs, User feedback is critical. FY 2019 COLE Functional Users Working Group prioritized requirements are driving development for CD 2. FY 2020 will include multiple Working Groups to review development with operators.</p> <p>-Initialize a JMEM program for EMS Fires. This effort will start in FY 2020 and is in response to Joint Requirements Oversight Council Memorandum (JROCM) 061-18 requesting Joint Munitions Effectiveness Manual (JMEM) for EMS Fires. CCMD mission planners require the ability to employ both kinetic and electronic attack (EA) methods to prosecute/affect advisory targets in contested EMS environments. Mission planners must be able to compare options side-by-side to have confidence in the effectiveness and understand associated risk. JTCG/ME will develop JMEMs capability for EMS Fires allowing mission planners to assess weapon/combat effectiveness in the presence of adversary EA on kinetic weapon guidance systems (i.e., Global Positioning System (GPS) Jamming), and to assess our EA capabilities against adversary targets (i.e., EMS Fires - EA Jamming). JTCG/ME will review and leverage existing models and data sets, where applicable, to build this capability. In addition, JTCG/ME will use kinetic weapon JMEM development model: 1) requirement collection/prioritization via Operational Users Working Groups, 2) Tri-service coordination, 3) leveraging/enhancing existing data/methodology, and 4) Joint standardization/approval.</p>			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>JTCG/ME will look to provide immediate capability, while developing/executing a long-term strategy for sustained JMEMs for EMS fires capabilities to inform the planning and requirements processes. FY 2020 efforts will include 1) developing EMS Fires JMEM strategy and plan, 2) collecting/coordinating requirements, 3) initiation of Tri-service team to review/approve data/methods, formulate processes to codify in charter/terms of reference, 4) further understanding current data sources/models, 5) building partnerships for data collection, 6) executing proofs-of-concepts, and 7) providing initial capability with weapon guides and data collection gaps/shortfalls.</p> <p>FY 2021 Plans: Live Fire Test and Evaluation (LFT&E) of Major Department of Defense (DOD) Acquisition Programs The FY 2021 budget will enable the LFT&E Deputate to assess the adequacy of LFT&E strategies/plans and generate new LFT&E policies to support systems' acquisitions and rapid fielding. The FY 2021 budget will ensure an adequate execution of the agreed upon LFT&E plans and subsequently ability to conduct independent analysis of survivability and lethality test and M&S data in support of the development of OSD Live Fire Test and Evaluation reports to Congress.</p> <p>JLF Programs and LFT&E Initiatives</p> <p>The FY 2021 budget will support a more lethal force by increasing the accuracy and capability of critical modeling and simulation tools to support test and evaluation efficiency and ensure credibility of DOD assessments and weapon engineering tools. JLF efforts will also resolve survivability and lethality related system design challenges of currently fielded U.S. systems. Finally, JLF will continue to lead innovation in LFT&E methods to increase LFT&E efficiency and support rapid fielding.</p> <p>JASP In FY 2021 the JASP will continue work on at least 25 multi-year RDT&E projects and initiate about 8 new projects approved by the JASP Principal Members Steering Group and OSD/DOT&E. The JASP will support the NDS objective to 'Build a More Lethal Force' by developing measures to defeat Near-Peer Adversary Threat (N-PAT) radio-frequency and infrared guided threats coupled with quantifiable improvements in digital and hardware in the loop modeling and simulation capability and credibility. Improve aircraft force protection by advancing system hardening against rocket-propelled grenade, small-arms, and high-energy laser threats and increasing threat and flight environmental situational awareness. Reform the DoD for Greater Performance and Affordability by funding the development of more efficient M&S tools and threat models to enable more effective aircraft survivability capability development, test and evaluation.</p> <p>The JCAT will continue to support the Air Force, Army, Marine Corps and Navy by assessing combat damage incidents, training operators on threat effects and combat damage assessment, and reporting their findings to combatant commanders and the DoD science and technology and acquisition communities. The JASP will continue supporting aircraft survivability education and</p>			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>information exchange through internet sites (restricted access and classified), by publishing the Aircraft Survivability Journal, developing educational materials and conducting training for the DoD and their contractors. The JASP will initiate, continue and complete other projects as approved by the JASP Principal Members Steering Group and OSD/DOT&E.</p> <p>Joint Technical Coordinating Group for Munitions Effectiveness In FY 2021, JTCG/ME efforts will continue to assist the DOT&E, OSD in supporting the National Defense Strategy lines of effort of enabling greater force lethality, strengthening partner capabilities, and optimal use of resources through efficiency.</p> <p>JTCG/ME will:</p> <ul style="list-style-type: none"> -Develop, enhance, and standardize data/methodologies for evaluating munitions effectiveness. This includes target vulnerability characterization, munitions lethality, weapon system accuracy, and specific weapon-target pairings driven primarily from current operational lessons learned, Joint Staff Data Calls, and CCMDs' needs. -Field and continue to enhance future versions of its major JTCG/ME Joint Munitions Effectiveness Manual (JMEM) products, the JWS, J-ACE, DCiDE tool, and DIEE. - Develop non-kinetic JMEMs capability to include COLE and Joint JLaWS products, as well as High Power Microwave (HPM) and EMS Fires data/tool sets. -Support specialized solutions to address operational needs to include direct analytical support to operations, Pk Lookup Tools, CDE analysis and tables, and munitions weaponeering guides. -Continue to execute a multi-year test program to enhance weaponeering/collateral damage estimation in complex environments. -Improve utilization of BDA data to more effectively and efficiently estimate munition expenditure rates and mitigate stockpile stress, while improving CCMDs' force effects. -Continue to maintain and strengthen relationships with the Warfighter, operational users, and coalition partners to establish requirements for current and future products, through forums, training, foreign military sales, and day-to-day operational support. The objective is to provide efficient and effective support to meet CCMD current and future needs for agility and greater lethality in a more dynamic combined operational environment. -Increase efficiency by leveraging ongoing Department efforts and support the Department's intent to complement U.S. interest and capabilities by providing weaponeering, targeting, and collateral damage estimation (prevent civilian casualties) capability to Coalition partners through foreign military sales. - Continue to build and implement the next JTCG/ME JMEM product lines on a foundation of effects libraries using software frameworks enabling quicker development, flexibility, leveraging, and tailoring. -Study and implement the use of machine learning and data analytics to improve quality of existing solutions, decrease computation time of applications, and answer question previously not possible. 			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
Specifically in FY 2021, JTCG/ME plans to:			
<p>-Sustain and field remaining updates to JWS v2.x product line. FY 2021 efforts will include multiple training and user forums for the fielded product. These forums are pivotal for J-ACE developers to understand requirements and align development efforts.</p> <p>-Delivery of JEL v1.0 (Spiral 1) capabilities to develop/complete JWS v3.x and DIEEE initial interfaces. JEL Spiral 1 capabilities include new/updated trajectory modeling, new weapon/targets database designs/data and user interfaces, enhanced structural target response and prediction, personnel vulnerability methods, Application Program Interface (API) to DIEEE, JEL processes, JEL model Smart Book, and EF training to solidify institutional EF development knowledge. FY 2021 efforts will include continued development of Spiral 2 capabilities, which include collateral effects radii tables, enhanced collateral damage mitigation, new ground mobile target capability and data, and new infrastructure targets (tunnels).</p> <p>-Support requirements collection by hosting JMEM training sessions, OUWG, and User help desk via the JPIAS. JTCG/ME will support approximately 30 training sessions anticipating about 500 students annually. These training sessions allow users to optimize use of JMEM capabilities, while providing JTCG/ME with critical input for future development. In addition, direct forward support to Combatant Commanders/Task Forces will be provided to enable target materiel development, weaponeering, and CDE solution development. JTCG/ME will collect User requirements and product use cases, to process and codify in capability needs statements used for planning and JMEM product development.</p> <p>-Facilitate coalition interoperability and information exchange forums. JTCG/ME will continue to deliver JWS version releases and standalone Pk Lookup tools to key coalition partners in support of current operations under FMS agreements, as well as migrate to new processes via the JEL/JWS v3.x concept. These FMS deliveries complement U.S. interest and capabilities by providing weaponeering and targeting capability to Coalition partners. JTCG/ME will also continue to hold information exchange forums via multiple IEAs. These exchanges facilitate collaboration on methodologies and efforts of mutual interest in the area of weapons effectiveness/collateral damage estimation.</p> <p>-Develop and enhance processes to supply target vulnerability data, weapons characterization data, weapons effectiveness methodology to operational and acquisition communities. The JTCG/ME develops and improves data and methodology used as tri-service standards. A focus of FY 2021 efforts is to continue to migrate data and methodology utilized through the JEL. JTCG/ME will continue to support and host technical working groups in targets, weapons, and methodology, as forums to share knowledge and build partnerships for greater leveraging, performance, and affordability. Leveraging existing technologies and partnerships have the potential to reduce the number of weapon test articles required and remove labor-intensive activities from weapon testing.</p> <p>-Update and execute strategic roadmaps for underlying vulnerability / lethality models used as standards by the tri-service community to better support JMEMs and LFT&E. These roadmaps align JTCG/ME funded and related tasks by other services and programs to facilitate leveraging. In addition, the roadmaps provide a tool for future investment planning to support modeling / simulation validation and resolution of capability gaps.</p>			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>-Develop and accredit CER Reference Tables in accordance with the latest CJCSI 3160.01, "No-Strike and the CDE Methodology" for air-to-surface and surface-to-surface weapons, which are the basic data that support the CDE methodology implemented in DCIDE and DIEE.</p> <p>-Maintain and support fielded DIEE v2.x versions. DIEE is an enterprise targeting solution that provides both seamless planning, linkage to various mission planning systems and tools in operational units. It is a GOTS product for advanced target development that integrates TCM, CDE, Weaponneering, and data basing functions.</p> <p>- Continue to develop future DIEE versions (v2.x/v3.x) with JWS 3.x linkage through the development of API. Focused FY 2021 efforts will continue to maintain/improve connectivity to community tools, implement interface with JEL emerging capabilities, transition battle damage assessment workflow and data capabilities from BDA analytical efforts, and maintain awareness of policy changes to applicable CJCSIs.</p> <p>-Support and deliver analysis packages for collateral damage mitigation, post-forensic, and force protection analyses packages to operational Users for high value targets in current operations. These efforts directly assist Combatant Commands to meet commander's intent and minimize collateral damage.</p> <p>- Continue the Enhanced Weaponneering and CDE Program, a multi-year test program focused on enhancing and validating JTCEG/ME CDE tools. This program will support improvements in weaponneering methodology to minimize risk to mission and risk to forces, while not increasing risk of collateral damage by providing foundational data for the development of higher fidelity predictive tools. Specific efforts will generate buried ordnance characterization data based upon usage statistics from CCMD Expenditure reports, and AOR specific building debris data to enhance and validate current weaponneering/collateral damage estimation methodologies required by Strike Approval Authorities. FY 2021 efforts will leverage seven FY 2020 testing events and multiple collaboration forums. FY 2021 efforts will include approximately four buried ordnance and four building debris characterization tests, as well as analyzing and transitioning data and findings from previous tests to weaponneering and CDE tools.</p> <p>-Continue to implement the BDA of Deliberate and Dynamic Strikes analysis. The effort is a multi-year task to analyze ongoing strikes required to update JMEM capabilities. The overall objective and intent is to ensure effective and efficient munition expenditure rates and mitigate the stockpile stress, while improving CCMDs' force effects. In essence, improve the warfighter's ability to get the right weapon on the right target, achieve the desired effect, and minimize collateral damage while optimizing scarce resources. FY 2021 efforts include: continued extraction of new strike data events, further refine strike analysis methodologies to increase automation, further development of new analysis tools obtain end user feedback on new tools / User interfaces, integrate BDA analysis tools with existing JTCEG/ME weaponneering applications, and shape BDA reporting standards.</p> <p>-Sustain/support fielded versions of J-ACE, which includes multiple training and user forums for the fielded product. These forums are pivotal for J-ACE developers to understand requirements and align development with other external debrief and analytical capabilities that use J-ACE as the underlying analytical engine to underpin results.</p> <p>-Field final J-ACE v5.x product capabilities, which will include updated weapons and aircraft data in JAAM, new cross platform BROWSE module, which contains descriptive information for each player (weapon, aircraft). In addition, J-ACE v5.4 will include</p>			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
<p>a new EM module that simulates terminal effects of the weapon lethality and target vulnerability. The faster EM has improved speed of new fuze model and refined graphic display data generation, and includes more weapon lethality-target vulnerability data sets. Other capabilities will include TSPI file updates and filtering/error identification, aircraft maneuver updates, new input/output control options for a "war room summary sheet, and initial ASW fly out model.</p> <p>-Integration of ACEL v1.0 capabilities in J-ACE v6.0/6.x. FY 2021 efforts will include finishing the review/approval of threshold capabilities, and continued integration and generation of standalone J-ACE application. ACEL v1.0/J-ACE v6.0 threshold capabilities include transitioned v5.x capabilities, unmanned aerial system features, enhanced weapon engagement zone methodology, new graphical displays, refined terrain masking options, and auto-generated test reports for each product player. Other efforts include finishing the development and starting the review/integration of J-ACE v6.0 objective capabilities into ACEL 1.x and J-ACE v6.0 respectfully. These capabilities include enhanced air-to-air missile modeling capability, more ASW fly outs, updated/new surface-to-air models, updated ESAMS capability with more counter measures, and target detection capability leveraging NASIC RF models/data. Begin to integrate longer lead development items into ACEL v1.x for future J-ACE v6.x product to include infrared detection/track, red surface-to-air gun modeling in EM, rotary wing aero performance modeling, and enhanced chaff modeling.</p> <p>- Continue Cyber JMEM development capabilities with continued execution of multiyear plan to develop the COLE tool. FY 2021 efforts will focus on completion of CD 3 that will include automated fusion of multi-domain estimates, correlation of foundational data to support OEM generation, preliminary artificial intelligence-based decision support system, OEM analysis and attack planning support, refined integration with other JTCG/ME toolsets, and quantitative comparisons. Similar to other JMEMs, User feedback is critical. FY 2021 will include multiple OUWGs to review development with operators and preparation for fielding products in future FYs.</p> <p>-Continue to mature DE JMEM capabilities to include High Energy Laser (HEL) and HPM weapons. FY 2021 DE HEL efforts will include continuing HEL lethality testing/target vulnerability analysis/data modeling for verification and validation (V&V) on service-specific target sets, field testing, continuing target vulnerability characterization and modeling to provide inputs to JLaWS tool, and conducting the accreditation of HEL JLaWS tool and collateral risk estimation PRA tool. FY 2021 DE HPM JMEM development efforts will include continuing HPM lethality testing/target vulnerability analysis/data collection for V&V on service-specific target sets, field-testing, target vulnerability characterization and modeling to provide inputs to JMEM models, finalizing HPM tool development, and completing the HPM PRA Tool.</p> <p>-Continue to develop/mature EMS Fires JMEM program and capabilities. FY 2021 efforts will build upon outputs of FY 2020 efforts and include execution of developed long-term strategy. FY 2021 will include efforts along JMEM development lines of effort to include: 1) Users interaction/requirements management, 2) Target vulnerability/threat characterization collection, standardization, and Tri-Service approval, 3) EMS Fire weapon characterization collection, standardization, and Tri-Service approval, 4) Effects Methodology development, standardization, and Tri-Service approval, 5) JMEM development management, integration, data</p>			

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management, Verification, Validation, and Accreditation (VV&A), and external interface, and 6) Lab/field testing to support data/ methodology gaps and VV&A.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> The increase from FY 2020 to FY 2021 of \$1.761 Million is consistent with increases due to Joint Munitions Effectiveness Manuals for Directed Energy and Electromagnetic Spectrum Fires, and inflation.			
Accomplishments/Planned Programs Subtotals		64.332	69.172
C. Other Program Funding Summary (\$ in Millions) N/A			
Remarks			
D. Acquisition Strategy N/A			